オスミウム同位体と強親鉄性元素組成からみたハワイ諸島、カウラ島産マントル捕獲岩の起源

Origin of mantle xenoliths from Kaula Island, Hawaii:Constrains from Os isotope and highly siderophile element compositions

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The Emperor Seamount-Hawaiian island chain is thought to originate from melting of a heterogeneous mantle plume, although the nature and extent of heterogeneity remain unclear. It has been suggested that some Hawaiian mantle xenoliths with highly unradiogenic Os isotope ratios (down to 187Os/188Os=0.1138) represent the depleted part of ascending Hawaiian plume, and that the depleted materials are more commonly distributed in mantle plumes than has been inferred from the compositions of erupted lavas. To better understand the lithological and geochemical variations of Hawaiian xenoliths and to evaluate the robustness of the above model, we conducted petrological and geochemical studies on 11 peridotite xenoliths (9 lherzolites, 1 dunite, and 1 wehlrite) collected from the island of Kaula, Hawaii. Here we present the results on the whole-rock Re-Os isotope systematics and highly siderophile element compositions in the xenoliths, together with the major element compositions of constituent minerals (olivine, clinopyroxene, orthopyroxene and spinel). The rock texture and mineral compositions indicate that the Kaula peridotites are samples from normal oceanic mantle and residues of variable degrees of melting. However, they have highly unradiogenic Os isotope ratios (down to 187Os/188Os=0.1187) yielding minimum rhenium-depletion ages of up to ~1.3 Ga, which are similar to those of O’ahu peridotites. Such unradiogenic Os isotopic compositions are not found in Hawaiian lavas and in depleted mantles (e.g., mid-oceanic ridge basalts). Importantly, as is observed in the O’ahu peridotites, the 187Os/188Os ratios of Kaula peridotites correlate with the degree of depletion, suggesting that they are related to an ancient melting event. Therefore, the Kaula peridotites are possibly the fragments of a Hawaiian mantle plume that consists of ancient depleted and recycled mantle lithosphere.

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